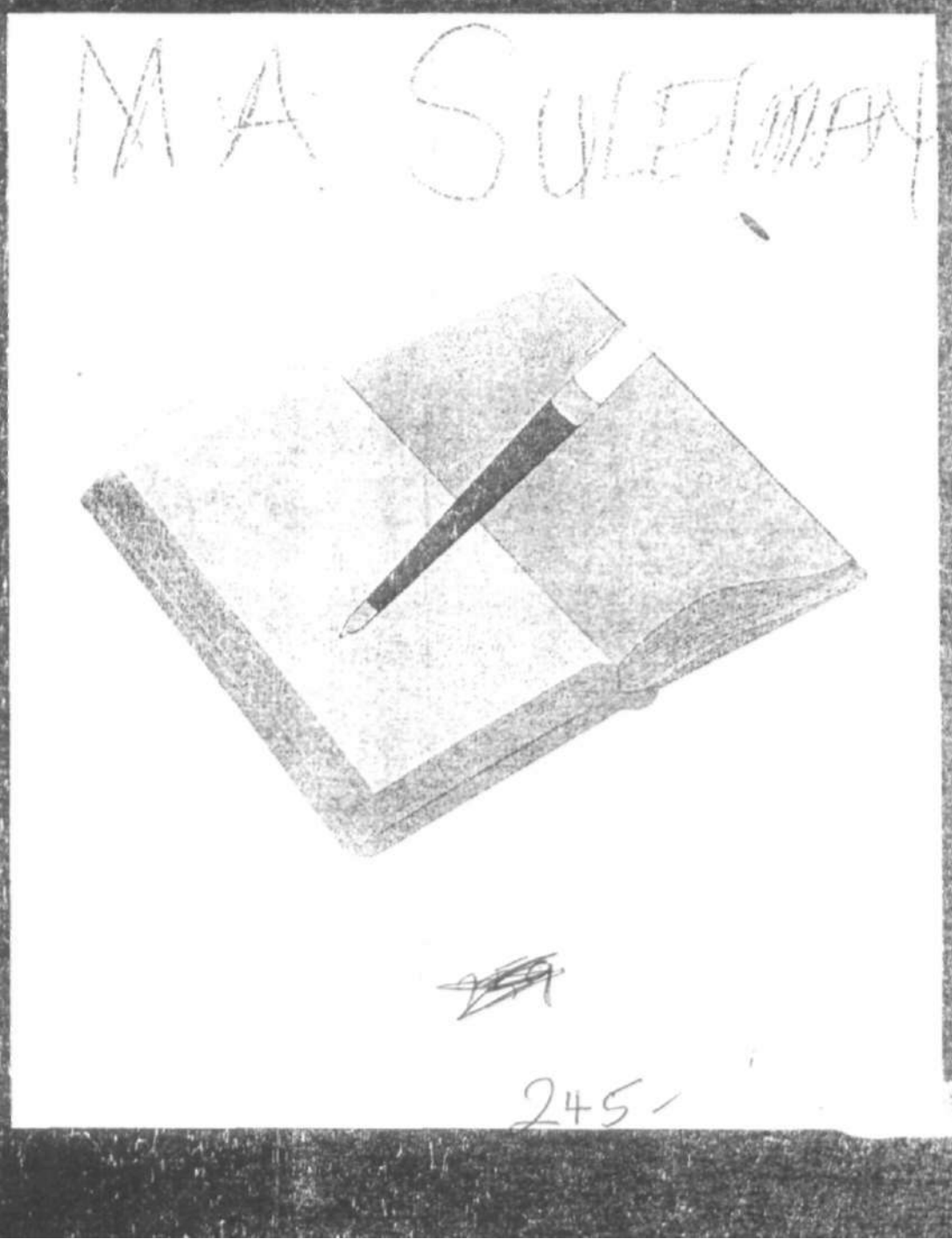
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DOES STRENUOUS TRAINING IN COMPETITIVE SPORTS AFFECT MYOCARDIAL RESPONSES TO COLD PRESSOR TEST?

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Abstract

The incidence of cardiovascular **disease has been increasing at a rapid rate** in recent time;. Health care **professionals and cardiologists have been** attempting to find **reliable methods of finding predisposition of** individuals to cardiovascular disease. **Cold Pressor Test has been** extensively used for this purpose. **This study was conducted to find out the** differences between **female athletes and non-athletes in their myocardial** response to Cold Pressor Test, in **order to infer the protective effect of** physical training against cardiovascular disease. Myocardial response was inferred from pulse **rate and double product (pulse rate multiplied by** systolic blood pre-sure) response **to Cold Pressor Test. Twenty female** university athletes and twenty **non-athletes females were selected at random** from **the female student population of Ahmadu Bello University,** Zaria to serve as **subjects** in **the study. Pre and post Cold Pressor Test** recordings of blood pressure and pulse rate and double product responses to Cold Pressor Test **among** female **athletes compared to non-athletes. This** is attributed to **improved myocardial function due to physical training,** which provides protective **effects against the incidence of cardiovascular** disease.

Introduction

Cardiovascular adaptation to acute exercise and training involves integration of neural and local factors. Neural factors constitute central command, baroreceptor reflex action, and neural reflex feedback from

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contracting muscle. During acute exercise, central command initiates activity in the sympathetic branch of the autonomic nervous system which results in increased heart rate, increased myocardial contractile force and peripheral vaso constriction (Carter et al ; 2003).

It also initiates a reset in the baro-reflex to a higher blood pressure set point. The frequency of baroreceptor firing is increased by an increase in blood pressure and decreased by a decreased in blood pressure. Stimulation of these barorecptors causes increased efferent cardiac parasympathetic activity and decreased sympathetic activity (Wernstedt et al; 2002; Rowland and Blum, 2000; Melanson and Freedson, 2003).

Available research evidence suggests that physical training, especially endurance training, increases parasympathetic activity and decreases sympathetic activity directed to the human heart at rest (Golgsmith et al; 2000; Venkateswarlu, 1992). These training induced autonomic changes in addition to a reduction in intrinsic heart rate, decrease resting heart rate and increases heart rate variability at rest (Goldsmith et al 2000; Venkateswarlu 1974; Wilmore et al; 1996). Recent studies have shown that the athletes have a lower resting heart rate and a more rapid heart rate recovery after exercise, attributed to increased parasympathetic activity resulting from prolong endurance training (Venkateswarlu; 1980). In addition, reduced sympathetic activity for any given submaximal exercise has been shown in endurance trained individuals compared to sedentary controls (Goldsmith et al; 2000).This study was conducted to verify whether university elite female athletes show similar myocardial responses to cold pressure test.

Method

To achieve the purpose of this study, twenty (20) female athletes and twenty (20) non athletes of Ahmadu Bello University, Zaria were selected at random to serve as the subject in the study. In a pre-post treatment research design, blood pressure and pulse rate of both female athletes and non-athletes were measure before cold pressure test. The subjects then immersed their right hand up to wrist level in a tub of water maintained at 4°c, during which the blood pressure and pulse rate measurements were taken. In this study, myocardial responses included blood pressure and double product.

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Testing Procedure

The whole experiment was conducted in the human performance laboratory of the department of Physical and Health Education, Ahmadu Bello University, Zaria. All the blood pressure measurements were taken between 4 and 6 p.m. for a week in June 2003. the subjects came from their respective dormitories to the laboratory. On their arrival to the testing centres they were allowed to rest for 10 15 minutes within which time their pulse rate stabilized. During the resting period, they were told about the purpose and the procedure of the investigation. Before the blood pressure measurements were recorded, the investigator ensured that the sphygmomanometer was in good order and that the rubber tube linking the inflation bulb with the mercury reserve wire was free of foreign matters and that the cuff itself was in good condition.

After the rest period, the subject was seated and instructed to be quiet, then the cuff was adjusted firmly as the tester located the brachial pulse in the anti cubital fossa and placed the bell of the stethoscope over the brachial artery. The cuff was inflated rapidly to 20 30mmHg above the pressure at which the radial pulse disappeared to palpation. The cuff was gradually deflated at a constant rate of 2 3mmHg per second. The mercury column was watched continuously and carefully. The systolic pressure was recorded point at which the last arterial sound disappeared (Korotokoff phase 5) was taken as the diastolic pressure. The pulse rate was also recorded at the time of taking blood pressure from the radial artery. Later, the double product was calculated as the product of pulse rate and systolic pressure.

Five (5) minutes rest interval was given to the subject before cold pressor test was administered. Subject was instructed to dip their hands inside the tub containing water that has been freezed to 4°C. Immediately after the subject immersed the hand up to wrist level, the blood pressure reading was taken. This was recorded as blood pressure response to cold pressor test.

Measurement of Pulse Rate

Middle and index fingers were used to locate the radial pulse on the outside of the wrist just below the base of thumb. Then the pulse rate was counted by using a stop watch for 15 seconds. This pulse rate was

multiplied by four to get the pulse rate per minute. This procedure was followed before immersion in cold water and during immersion in cold water.

Determination of double Product

Double product is the product of pulse rate times systolic blood pressure. The procedure for measurement of pulse and blood pressure was already described.

Results

The results of this study showed that the pre-immersion blood pressure and pulse-rate of female athletic and non-athletic groups were within normal range. However, blood pressure, pulse rate and double product responses of female non-athletic group to cold pressor test were much greater than those of female athletic group (see table 1).

Table 1: **Means and Standard Deviation of Pre-and post-Immersion Blood pressures, Pulse rates and double Products of Female Athletic and Female Non-Athletic**

The results of this study showed insignificant differences between female athletic and non-athletic groups in their pretest blood pressure, although significant differences were found between these two groups in their pretest pulse rate and double product. (See table II).

Table II: t-Ratio for Differences Between Female Athletic and Non-athletic Groups in their pretest Blood Pressure, Pulse Rate and Double Product

roup	Blood Pressure						Pulse Rate			Double Product		
	SPB			DBP								
	M	SE	t	M	SE	t	M	SE	t	M	SE	t
. Female thletic group	101.450			75.00			76.25			7703.5		
		1.19	1.40		1.66	1.49		3.25	1.80		163.8	2.56
. Female Non-athletic roup	103.50			72.00			78.50			8128.9		
t (38) = 2.021 < 0.05												

This study showed significant differences between female athletic and non-athletic groups in their diastolic blood pressure, pulse rate and double product responses to cold pressor test. However, no significant difference was found between female athletic groups in their systolic blood pressure response to cold pressor test. This insignificant difference appeared to be mainly due to greater variability of systolic blood pressure response (SE = 2.66) of the female non-athletic group to cold pressor test (See table III).

Table III: t-Ratio for Differences Between female Athletic and Non-athletic
Groups in their Post-test Blood pressure, Pulse Rate and Double Product

Group	Blood Pressure						Pulse Rate			Double Product		
	SPB			DBP								
	M	SE	t	M	SE	t	M	SE	t	M	SE	t
a. Female athletic group	109.450	1.53		74.50	1.14		90.95	1.69		9947.5	216.5	
			1.80			2.65			2.65			2.56
b. Female Non-athletic group	125.00	2.66		79.50	1.35		85.35	1.26		1066.7	275.87	
t (38) = 2.021 < 0.05												

As it was not clear whether the differences found between female athletic and non-athletic groups in their responses to cold pressor test were due to the pre-immersion differences, it became necessary to eliminate the influence of pre-test differences between groups in their blood pressure, pulse rate and double product responses to cold pressor test by applying analysis of covariance (ANCOVA). The results of this analysis showed insignificant differences between the groups in their systolic as well as diastolic blood pressure responses to cold pressor test. In other words, the

significant differences between groups in diastolic blood pressure response appear to be mainly due to pre-immersion differences between the groups. The ANCOVA eliminated the initial differences. However, the differences between the groups in their pulse rate and double product responses remained significant which may be attributed to cold stress.

The mean pulse rate of the female athletic group was higher than its non-athletic counterparts (90.93 and 85.35 respectively). However, the mean double product response of the female non-athletic group to cold pressor test was significantly higher than that of the female athletic group (1066.70 and 966.07). (See table IV).

Table IV: Analysis of Co-Variance for Difference between Groups in their Blood Pressure, Pulse Rate and double product Responses to Cold Pressor Test

Blood Pressure					Diastolic pressure					Pulse Rate				
Systolic pressure														
M	SD	Diff.	t	PV	M	SD	Diff.	t	PV	M	SD	Diff.	t	PV
105.5	2.16	2.00			75.00	6.07	2.50							
			4.30					1.48		76.29	4.13	2.25	4.50	
109.50	6.86	2.00			71.5	5.10	2.50			90.93				
				107.89					77.63					81.41
103.5	4.89	2.00	1.30		72.50	4.41	2.50	1.48		85.5	4.9	2.25	4.50	
125.00	11.92	2.00		123.42	79.50	6.05	2.50		81.13	85.35	4.5	2.25		92.35

These significant differences in both pulse rate and double product responses could be attributed mainly to the effect of cold stress on the two groups. The female non-athletic group reacted to the cold pressor treatment with a higher mean value of the double product. As for the female athletes, they were able to withstand the stressed imposed by the cold pressor treatment, hence a lower mean value for the double product.

Discussion

The results of this study showed that the blood pressure, pulse rate and double product of both athletic and non-athletic groups were within

normal range. This is attributable to the fact that both athletic and non-athletic groups were subjects without any medical complications that would otherwise not have qualified them to participate in the study as subjects. However, the responses of athletic and non-athletic groups to cold pressor test in their blood pressure, pulse rate and double product were significantly different. It became necessary to analyse the factors responsible for these differences.

The results showed insignificant differences between female athletic and non-athletic groups in both systolic and diastolic pressures, and their pulse rate before immersion in cold water maintained at 4°C. However, the pre-immersion recording of double product of non-athletic group was significantly higher than that of the athletic group. This may be attributed to the fact that the myocardial oxygen demand in inactive people is usually higher than that in the physically active people. It was also observed that cold stress effect was greater on the pulse rate of the non-athletes (Mitchell, 1981), though, myocardial oxygen demand is principally determined by wall stress, heart rate and contractile state (Klocke and Ellis, 1981). This explanation is justified by the fact that the double product is considered as a useful clinical method for estimating the myocardial oxygen demand, which has been used extensively in the evaluation of patients with coronary artery disease and in the response to therapy in these patients. However, it may not be useful with regional myocardial ischemia, which is better e valuated by abnormalities in wall motion, although, it serves as a good measure of total left ventricular myocardial oxygen consumption.

The results of this study showed insignificant difference between pre and post immersion blood pressure of both female athletic and non-athletic groups. This finding implies that both groups were not so hyper-responsive that significantly elevated blood pressure could be observed as a response to cold stress. As hyper-responsiveness to laboratory stressors like cold pressor test has been associated prospectively with coronary heart disease and hypertension (Mathews et al, 1986; Keys et al, 1971), the absence of hyper-responsiveness of the subjects to cold stress in this study is indicative of their sound cardiovascular health. The significant differences between pre and post immersion pulse rate and double product of both female athletic and non-athletic groups may be explained on the

basis that the responsiveness to cold stress is more immediate and significant in magnitude in pulse rate and double product. This higher responsiveness in pulse rate and double product, however, may not be adequate to associate it prospectively with cardiovascular disease, because this was not accompanied by a similar hyper-responsiveness in blood pressure. However, effect of age could also be considered in the response of both groups to cold stress.

When pre-test differences between the groups in their blood pressure were not considered, the difference between the groups in their diastolic blood pressure response to cold stress was found to be significant. However, when the pre-test differences between groups were considered, the difference between the groups in their diastolic blood pressure response to cold stress became insignificant. Thus, the significant difference between groups in their diastolic blood pressure response is attributable to pre-test difference betweens groups and not to the difference between their responsiveness to cold stress. The fact that the difference between the athletic and non-athletic groups in pulse rate and double product remains significant even after eliminating influence of pre-test differences is suggestive of the relative unfitness of the non-athletic groups. This may be further justified by the fact that regular physical training improves cardiovascular health and fitness as evidenced by a lesser response to any stress in cardiovascular variables. In this study, the female athletic group had sound and extensive athletic training background which their non-athletic counterparts lacked. It was therefore not surprising to find a greater response of non-athletic group to cold stress in cardiovascular variables than their athletic counterpart. However, it was not possible in this study to predict the chances of development of hypertension among the hyper reactors. It could be interesting to study the magnitude of responsiveness in blood pressure to cold stress that would be a clear marker for the future incidence of hypertension.

Conclusion

On the basis of the results of this study, it is concluded that strenuous athletic training provides protection against myocardial inefficiency by improving myocardial responsiveness to stress.

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